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THE SUGAR CANE DISEASE
SITUATION IN 1923 AND 1924

BY

C. W. EDGERTON, W. G. TAGGART and E. C. TIMS
The Sugar Cane Disease Situation in 1923 and 1924


On account of the serious situation confronting the Louisiana sugar industry at the end of the season of 1924 as a result of a series of poor crops, it seems advisable to put on record the actual conditions with a discussion of the possible causes and the work that is being done to bring the crop back to normal. The poor crops have resulted in a great deal of discussion and various opinions have been expressed as to the cause or causes. Some persons hold the opinion that the sugar industry of Louisiana has reached a crisis and they freely predict that it can be saved only by a complete change of varieties. At the other extreme, some believe that with proper treatment of our present varieties, they can be brought back to a satisfactory condition. Some of the various opinions are founded on ideas and statements which are not justified by the facts.

If, as a result of the present situation, the present cane varieties are replaced by others, then a careful analysis of the different possible causes will be of value. Other sugar countries have had their troubles in the past which resulted in the change of varieties. In some countries, varieties have come and gone a number of times. The cause of some of these changes is known, but unfortunately, it is not perfectly clear for some of the others. Possibly the most outstanding example of a variety being discarded without definitely ascertaining the cause, was the abandonment of the old Bourbon cane in the British West Indies in the nineties. The cane of this variety went to pieces and at the time it was attributed to the rind disease, just as today the mosaic is getting the credit for our Louisiana troubles, yet no one today who knows cane diseases, believes that the rind disease was the cause.

If on the other hand, the D 74, Purple and Striped varieties remain, then a knowledge of the causes of the present situation may aid in a more rapid recovery and help to prevent future trouble.
Crop Conditions

At the close of the season of 1924, the crop conditions in the sugar belt of Louisiana were worse than they had been for a great many years. The crop of 1923 had been short while that of 1924 was almost a failure. The industry had suffered short crops before but probably never two in succession.

The crop of 1923 showed a low yield per acre, only 11.1 tons. This, however, was not as low as the crops of 1912, 1915, and 1919. The borer infestation was heavy and the infection with red-rot very high. The cane used for seed in the fall, as a result of the borer and red rot, was very poor, possibly in the worst condition it had been for years. Furthermore, this bad seed was planted in soil that had remained watersoaked through a greater part of the season.

The crop of 1924 started off poorly. The germination in the spring in many places was low and this resulted in many poor stands. Both the plant and the stubble cane showed the gappy stands. Following this bad start, in some localities many of the young plants died when they were from six to fourteen inches high. Then the growth during the whole season was very slow. There was considerable variation in growth in different fields and in different areas in the same field. There were spots with poor cane and spots with fairly good cane. The even growth which is characteristic of a good cane field was quite generally lacking.

There was also some variation in the cane in different sections of the state. In a few places, the cane was very good. Some cane cut up to 25 tons to the acre in favored spots in the lower coast district, while yields of 35 tons were expected on some of the reclaimed soils. In other sections, however, the crop was so poor that a considerable percentage was not worth cutting. This variation in different sections is best shown by quoting from the November 1 Crop Report, prepared by Lionel L. Janes, Agricultural Statistician of the United States Department of Agriculture.
“Sugar cane continues in better condition on the average in the Louisiana cane belt than in the outside parishes. A number of reports indicate that outside the cane belt there will be scarcely enough seed to replant the harvested area.

“The percentage condition of sugar cane in the cane belt by parishes on November 1, 1924, is as follows, comparison being with a normal condition of growth and vitality giving promise of a full yield per acre represented by 100 per cent:


The low condition of some of the western parishes such as Lafayette, Vermilion, St. Martin and St. Landry is worthy of notice. This will be considered in the discussion on weather conditions and mosaic later in this bulletin.

The sucrose content of the cane at grinding time in 1924 was running abnormally high. Analyses of 15 and 16 per cent. sucrose and even higher, were being reported from some of the mills. This high sucrose content will offset to some extent the low tonnage.

The cane used for seed in the fall of 1924 was exceptionally good. There were comparatively few borers and the red-rot infection was low. When sufficient moisture was present, the canes germinated with more vigor than usual. This was particularly true in fields with selected seed. New plantings with nearly a perfect stand were seen before the middle of November. In some fields that were dust dry, seed planted early in October failed to germinate and deteriorated badly. Some of these, if not replanted, will doubtless show very poor stands in 1925. Fields, however, with sufficient moisture, either from local rains or irrigation, to start germination give promise of excellent stands of vigorous cane.
As a result of the poor crops of the last two years, some planters and others interested in the sugar industry have expressed the opinion that the Louisiana cane varieties have been degenerating for a number of years and that they are not now capable of producing as they did at an earlier period. The reasons as usually given are: (1) from year to year the cane has become more and more affected by disease; (2) the general practice of planting the poorest and most diseased cane has resulted in a weak or more or less degenerate condition. As to this point, a comparison of the crop yields over a considerable period will give the best information. In Table 1 are given the data on the Louisiana sugar crops for the last twenty-four years. These data were obtained from the Year Books of the United States Department of Agriculture. Besides giving the total yields for the whole period, the table also includes the yield per acre and the sugar per ton of cane for the period since 1911.
<table>
<thead>
<tr>
<th>YEAR</th>
<th>Area cut for sugar</th>
<th>Yield per acre, tons</th>
<th>Sugar made tons</th>
<th>Sugar per ton pounds</th>
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<tr>
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<td></td>
<td></td>
<td>360,277</td>
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<td>231,200</td>
<td>18.0</td>
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<td>1919</td>
<td>179,900</td>
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<td>129</td>
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<td>1920</td>
<td>182,843</td>
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<td>226,366</td>
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<td>217,259</td>
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<td>1924*</td>
<td></td>
<td>7.2</td>
<td>115,261</td>
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</table>

*Crop Estimate of November 1.

An analysis of this table shows that in the period between 1901 and 1911, the yearly variation in yield was not very marked, but during the period since there have been a number of years with short crops, as for example, 1912, 1915 and 1919. It is also seen that in this latter period, there were some years with very excellent crops and that one of the best of these occurred as late as 1921.

If the sugar crops have been deteriorating, when did the decline begin? It might possibly be said with the first poor
crop of 1912. If so, then it is difficult to account for the very good crops that have been grown since that time. The only other time to start the decline is immediately after the most excellent crop of 1921. However, the very adverse weather conditions of the past two years so complicate the situation that it is not possible to say what the crops would have been under normal conditions. As a matter of fact, the data on crop yields offer no proof of any actual deterioration or running out of the varieties. They do, however, suggest one thing and that is, that the various diseases are perhaps becoming more prevalent and in years favorable for their development, they may reduce the crop to a considerable extent. There is no evidence to show that free of these diseases, the cane will not produce just as well as formerly.

Causes of the Poor Crops

The following analysis of the causes of the poor crop condition follows a very thorough study of the situation in the whole sugar belt. The various sections have been visited many times from very early in the spring until grinding time in the fall. Furthermore a series of meetings were held in September, 1924, by members of the Experiment Station and Extension Division and the situation was discussed with a very large number of planters.

A number of factors have been suggested as possible causes of the poor crops. The ones which seem important are: weather conditions; unsatisfactory cultivation, drainage and fertilization conditions; cane borer infestation; and the attack of several cane diseases. While these different factors will be considered separately, it should be kept in mind that the actual crop condition developed as a result of a combination of these rather than any single one.

Weather Conditions

The weather conditions of both 1923 and 1924 were very unsatisfactory for cane production. 1923 was very wet, being one of the wettest years known, while 1924 was
just the opposite being the driest year on record. The actual condition can best be given by quoting from the reports of the United States Weather Bureau.

In the summary for 1923, the conditions for that year are expressed as follows:

"The average precipitation (for 1923) was above normal in all months except January, which was slightly deficient. Except for 1905, the annual average precipitation was the greatest during the period of Statewide record. — There was too much rain for the best development of most crops, especially cotton and sugar cane. —Frequent rains at critical times prevented needy cultivation of sugar cane in numerous localities, so that the period of cultivation closed with numerous grassy fields. —Grinding of cane began in October and was generally completed by the close of the year, with yield below normal for the tonnage, which was light. A good fall planting of sugar cane was secured."

The soil remained water-soaked through most of the season of 1923 and consequently was in a very bad physical condition at planting time in the fall. The soil remained wet through a considerable portion of the winter of 1923-24 as January, 1924, was also a wet month. Following this period, however, the weather turned off dry and for the whole of the growing season of 1924, the precipitation was far below normal except in a few localities. In many sections, from February until the end of the season, every month showed a precipitation less than normal. The growing months of July, August and September, the months in which a heavy rainfall is needed, were particularly dry.

Quoting from the United States Weather Bureau report for the Louisiana section for August:

"The month was the warmest and driest August during the period of Statewide record. —The drought, beginning in June, this year, and continuing into September, is unprecedented for light summer rainfall in Louisiana during the period of the Statewide record of 34 years. The total of the averages for June, July and August, 1924, was 6.84 inches. The nearest to this for the same months, was 9.87
inches in 1902. The drought injured all crops. Sugar cane prospects were materially reduced.”

The final Weather Bureau Summary for the year is not as yet available. The drought, however, continued through September and October and was not broken until November 20.

The drought did not affect all sections to the same degree. In some places, there were local rains which were of considerable benefit. In Table 2, is given the rainfall as published by the United States Weather Bureau, for a number of places in the sugar belt. Some of these figures do not show the actual conditions even for the surrounding territory on account of the small area covered by local rains. For instance, Baton Rouge is given a rainfall of 3.25 inches for August. Most of this was due to a local shower that was confined almost entirely to the city limits. Four miles away at Cinclare, the rainfall for the month was only 1.38 inches. In general, however, this table shows the variation in rainfall in different sections. Some sections like Houma were favored with considerably more rain than other parts of the state. Other sections received practically no rain during the months of July, August, September and October.

**TABLE 2**

RAINFALL IN SUGAR BELT IN 1924. INCHES

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<th></th>
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<td>5.00</td>
<td>3.76</td>
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<td>3.72</td>
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<td>7.67</td>
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<td>3.22</td>
<td>1.84</td>
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<td>Houma</td>
<td>6.41</td>
<td>6.90</td>
<td>1.63</td>
<td>1.84</td>
<td>5.20</td>
<td>4.43</td>
<td>2.74</td>
<td>3.43</td>
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<td>2.50</td>
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<td>0.67</td>
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<td>3.66</td>
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<td>0.86</td>
<td>3.33</td>
<td>2.92</td>
<td>2.88</td>
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What effect have these drought conditions had upon the crops in the sugar belt? If the rainfall of the various localities is compared with the crop condition of November 1 as given on a previous page, it is seen that there is a very close relation between rainfall and crop conditions. East Baton Rouge with a crop condition of 18 per cent, Lafayette with 23 and St. Landry with 24 are all in localities with the scantiest rainfall, while Terrebonne represented by Houma records, with more rain had a crop condition of 55 per cent. Even if there had been no diseases or insects present and the soil had been in the best of shape, a satisfactory sugar crop could not have been raised under the drought conditions experienced in 1924. Evidently, then, the rainfall conditions must be considered as very important factors and responsible to a considerable extent for the poor crops of recent years.

Another weather condition must be mentioned though its influence on the crop conditions is not clear. The winter of 1923-24 was exceptionally cold. The following low temperatures in January were reported to the Weather Bureau: Angola, 11°; Baton Rouge, 15°; Houma, 16°; Franklin, 18°; Lafayette, 17°. With the cane lying in a watersoaked soil, it is possible that these low temperatures had an influence on the poor germination in the spring.

**Cultivation, Drainage and Fertilization Conditions**

For a number of years, the average cultivation and drainage conditions in Louisiana have not been held at the normal. Labor and climatic conditions have prevented proper cultivation and have held back the proper drainage work.

During the war and for some time afterward, labor was scarce and high priced. As a result, cultivation was often slighted or not done at the proper time. During 1923, climatic conditions prevented proper cultivation and drainage work. For weeks at a time, it was impossible to do anything in the fields on account of the continued rains. The fields became grassy and the soils packed.
As a result with the opening of the year, 1924, the soil generally was in an unsatisfactory condition. In digging up poorly growing plants during the summer of 1924, it was the usual thing to find the soil very firmly packed under the plants. Often the roots were confined entirely to the upper few inches of soil that had been stirred by the cultivator. They seemed unable to penetrate the hard ground below.

The soil remained practically saturated through a considerable portion of 1923. It was not uncommon to see the rows full of water over considerable areas and for considerable periods. Possibly no reasonable system of drainage would have been satisfactory under such moisture conditions. Yet it must be borne in mind that a saturated soil is not suitable for root development and is very favorable for the spread of root parasites. Many fields in 1924 showed very plainly the effect of unsatisfactory drainage conditions in 1923.

The effect of drainage has been brought out recently in an article by Mr. John M. Caffery (3). From results obtained on Columbia plantation, the depth of the drainage ditch has a considerable influence on the yield of both plant and stubble cane. A deeper ditch gave a considerably higher yield.

It has been suggested that the Louisiana soils are becoming depleted of the necessary plant requirements and that they are not now capable of producing the crops of former years; in other words, the fertilizers ordinarily applied have not been sufficient to keep the soils in a productive condition. As a matter of fact, there is no evidence that this is the case. Some fields have been allowed to run down and without doubt are not producing what they should but there is no evidence that they could not be brought back in a reasonable time. Depletion of soils and an unsatisfactory condition due to improper treatment are two different things. There is no question but what those fields with a good humus content which was produced by plowing under the cowpea and Melilotus crops, withstood the dry season
of 1924 better than did the fields that had the cowpeas removed for hay as the soils with the humus held the moisture better than did those without.

The various field practices mentioned above, including cultivation, drainage and fertilization, have had some influence on the crop conditions of the past two years. They have without doubt been partially responsible for some of the differences observed in various localities. There is little question that a more general practice of plowing under legumes and more attention paid to the drainage conditions would raise very materially the tonnage of the Louisiana sugar crop. However, it is not believed that these are the most important factors in the present crop conditions.

Cane Borer Infestation

The cane borer has had its influence on the Louisiana sugar crops for many years. In some years, it has been more troublesome than in others. In 1923, there was a very heavy infestation. In some localities, in the fall of that year, it was difficult to find a stalk without a borer hole. In 1924, however, there was a comparatively light infestation. Not until late in the season did the borers begin to increase rapidly.

The borer, besides decreasing the weight of the cane and making the fibre content higher, permits the entrance of the red-rot disease. In 1923, the red-rot disease was extremely prevalent and this was in a degree made possible by the borer. While the borer was partially responsible for the poor stands of 1924, it could have had no influence on the growth of the crop during the summer.

The Diseases of Cane

The various diseases of cane have had a considerable influence on the present cane condition in Louisiana. There are three distinct diseases which should be kept in mind, these being the red-rot, the root-rot and the mosaic. These diseases have been under observation by the Experiment Station during a period of years.
The Red Rot

The red-rot is a disease which has been in Louisiana for a long period. It was first reported in 1910 (6, 7) but had doubtless been here for a long time previous to that date. It came under observation following a condition somewhat similar to the one in the state in the spring of 1924. The cane germinated poorly and came up to a thin stand. In order to ascertain the cause the Plant Pathology department of the Experiment Station obtained canes that failed to germinate from many of the sugar parishes. It was found that a very considerable percentage of the stalks was affected with the red-rot disease.

Red-rot is a disease that is known in many of the sugar producing countries. In some places, it does considerable damage while in other countries it does not seem to be so important. In India, it is apparently the most important of the sugar-cane diseases.

The red-rot is a disease confined largely to the inside of the stalk and consequently it is not readily recognized in standing cane. It is best seen when the cane is cut for planting or for the mill. If an affected stalk is split open, the disease shows to the best advantage. The inside of the stalk has red areas with elongated white spots running transversely across the red (Fig. 1). These white spots always show the presence of the red-rot and they make it easy to distinguish the disease. Any borer channel or other injury in a cane stalk will be surrounded by red tissue but unless the red-rot is present, there will not be any white spots within the discolored portion.

The fungus causing the red-rot enters a stalk either through a wound such as a borer hole or through the root buds on the nodes. All stalks infested with the borers are of course not affected with red-rot. The percentage of bored stalks infected with red-rot varies considerably in different years and in different fields. Fields have been seen in which fifty per cent of the bored stalks were also infected with red-rot but this is higher than ordinary.
Fig. 1. Red-rot in split stalks of sugar cane. Notice the elongated white spots which are characteristic of this disease. From the crop of 1923.
The effect of red-rot is to reduce the sucrose content of the growing cane and to decrease the germination of the cane that is planted. Since the discovery of the disease in Louisiana, the Experiment Station has carried on rather extensive investigations with it and the results have been published in several bulletins (7, 8, 11).

The decrease in sucrose of the growing cane due to red-rot varies considerably depending on how early the cane becomes infected. If a stalk becomes infected while it is quite small, a very large per cent of the sucrose is used up by the fungus; if the infection takes place later in the summer, the decrease will not be so great. On an average, infected stalks will show a juice analysis of around 25 per cent less sucrose than uninfected stalks. If the number of stalks infected in a field is small, the total loss will be small; but if the percentage of infection runs high, the sucrose content of the juice at the mill will be appreciably lower.

As to the effect on germination, the red-rot becomes an important factor. Stalks affected with red rot germinate very poorly and this is one of the reasons for the low germination in the state. The average germination of the eyes in Louisiana is about 20 per cent. In order to obtain good stands, the Louisiana planter is compelled to use considerably more seed than is used in the tropics. While there are factors other than the red-rot concerned in the poor germination, it has been demonstrated that red-rot cane germinates much poorer than healthy cane. All that is necessary to obtain a thin stand is to inoculate the planted stalks with red rot.

In the season of 1923, the red-rot infection was as high as it has ever been seen in Louisiana. The very wet season combined with the heavy borer infestation made conditions ideal for the spread of the disease. Examinations made at the mills at grinding time showed this disease in great abundance. This very heavy red-rot infestation was one of the causes of the very low sucrose content of the juice in 1923.
This very heavy red-rot infection was also partly responsible for the very poor stands obtained in the spring of 1924. Trips were made over a greater portion of the sugar belt during the early part of the season. Hundreds of the old seed stalks which failed to germinate were dug up and examined. The percentage of these stalks showing typical red-rot was very large, apparently 75 per cent or more. Furthermore, on digging up the old stubbles that failed to grow, the same condition was found. These were just as severely infected with the red-rot as were the planted stalks. As it has been demonstrated that red-rot will cause just such a decrease in germination, the presence of such a heavy infection explains very largely the poor, thin stands of 1924.

Notwithstanding the fact that the spring started with a very heavy red-rot infection, there was very little spread of the disease in the growing cane during the season of 1924. This is easily accounted for by the very dry season which prevented the development and spread of the red-rot fungus and by the light borer infestation during the early summer months. Consequently at the end of the season there was very little red-rot. The very high sucrose analyses that were obtained at the mills would not have been possible with a heavy red-rot infection.

The cane used for seed in the fall of 1924 was exceptionally good on account of its freedom of the red-rot. The seed that was planted in soil containing sufficient moisture germinated extremely well. Some fields planted with selected cane were showing germinations of 70 and 80 per cent. However, red-rot was not entirely absent. In one field in which the seed was planted in early October in soil too dry for germination, out of approximately forty stalks examined on November 11, three showed the red-rot. Very little of the cane in this field was germinating but this was due to the fact that the stalks were drying and deteriorating from lack of moisture and not due to an excessive amount of red-rot.
The Mosaic Disease

The mosaic is a disease which has been in Louisiana for a period of approximately ten years. It was first reported in the United States by the senior writer of this bulletin in June, 1919, (9), following the receipt of a letter from Porto Rico in which it was stated that cane received from Louisiana had developed the disease. The disease had been seen for several years previously in Louisiana but had not been connected with the then little known mosaic disease on account of the apparently small damage it was doing. As a circular was later published by the Extension Division (10) and a bulletin by the United States Department of Agriculture (2), the planters have had the opportunity to become acquainted with the disease.

How the disease was introduced into the United States is not known. For many years, cane has been imported from various parts of the tropics by the Louisiana Sugar Station, by the United States Department of Agriculture and by numerous planters in the Gulf States. There was abundant opportunity for the disease to be introduced. The only surprising thing is that is was not introduced into the United States earlier than it was. When the disease was first recognized in the United States, there were centers of heavy infection in the river district of Louisiana and in areas in Georgia and Florida. The United States Department of Agriculture made surveys in Louisiana in 1919 and 1920. There was then but little of the disease west of the Atchafalaya river and only a small amount in the upper Bayou Lafourche district. In 1921, the Louisiana Experiment Station made a survey in the Bayou Teche district. Late in the summer of 1921, there was a five to ten per cent infection at Houma, a very small infection at Franklin, an occasional plant in a few fields at Jeanerette and practically none west of that. The disease has been spreading rapidly and in the time since has spread over the whole sugar belt. However, in 1924, the infection in the western part of the state had not reached the 100 per cent mark.
The mosaic disease produces a mottling or striping of the leaves, a condition which has become familiar to most planters. The stripes are lighter in color than the normal leaf. Affected leaves as a result are often distinctly paler than healthy ones. Destroying the green coloring matter in the leaves prevents the plant from functioning normally in its manufacture of food material.

The effect of mosaic is to retard the growth of the plant, or in other words, to reduce the tonnage. Unlike the red-rot disease, it has no influence on the sucrose content of the juice. Juice from affected plants will analyse at the mill just as well as from healthy plants.

How much loss the mosaic causes is a question. It is difficult to conduct a satisfactory test. For a test to be satisfactory, healthy and diseased seed cane should be planted side by side under similar conditions. If this is attempted, a greater portion of the healthy cane will be diseased before the year is over. Furthermore, for a satisfactory test, the healthy and diseased cane used for planting should be taken from the same field. That seed from different fields may give markedly different yields is a fact well-known to most sugar men.

The literature from various sugar countries contains many estimates of mosaic losses. While some of these are merely guesses, others are founded on tests of various kinds. These various estimates range all the way from about 5 per cent up to nearly 100 per cent. The most popular estimates found in the literature seem to be 30 to 40 per cent.

Loss estimates have been attempted in Louisiana in three different ways.

(1) Healthy cane from out in the state has been brought to Audubon Park and planted by the side of diseased cane which had been grown at the Experiment Station. These tests gave very variable results, some times the outside cane producing more and sometimes less than the Station cane. There are so many variable factors in such an experiment, including the vigor of the cane, the
stands obtained, the presence of other diseases, etc., that the results are unreliable and of little value.

(2) Healthy and diseased seed of the L 511 variety has been selected from the same field and planted under the same conditions. While this variety is subject to the disease, it is more resistant to infection and the disease spreads but very slowly during the season. Reliable data have been obtained with this variety. In three successive years the decreased yield from the infected seed was about 10 per cent.

(3) Canes of the D 74 and Purple varieties showing very little effect of the disease have been selected and planted by the side of diseased stalks of the same varieties and from the same fields. Gains from the selected seed have ranged from 8 to 35 per cent but other factors also enter here. The selected cane usually showed a greater freedom of root rot and other troubles also.

With the ordinary varieties, it is doubtful if the mosaic produces a loss greater than 10 per cent in Louisiana. Varieties show a great difference in regard to mosaic. Many of the seedlings and tropical varieties which have been grown at the Sugar Station are injured very severely by the disease but varieties like the D 74 show a considerable amount of tolerance. While a loss of 10 per cent makes the disease an important factor, it is evident it is not the only factor in the present short crop.

There is a statement found frequently repeated in articles on sugar cane mosaic which is not entirely justified from the observations made in Louisiana. It is said that infected cane deteriorates from year to year. By this is meant that the disease produces a slight loss the first year, a somewhat greater loss the second year, a still greater loss the third year, and so on. If this were so, there should be a comparatively light loss in the western part of the state and a very heavy loss in the eastern part at the present time. In sections like Reserve, the disease has been present for a number of years as this is one of the oldest centers of infection in the state, while in districts like Lafayette the mosaic is just becoming firmly established. If the loss from
the disease increases from year to year, the condition of the cane should be worse at Reserve. As a matter of fact, the reverse was true. The cane at Reserve this year, in spite of the fact that there was practically no rain after June, was considerably better than in the Lafayette district. This is also shown by the November 1 crop report. St. John with 47 per cent and St. Charles with 60 per cent shows a considerable better condition than Lafayette with 23 per cent.

Furthermore, from very extended observations, there was no evidence to show that the loss from mosaic in 1924 was any greater on the old infected plantations than on those on which the disease had just become firmly established. As a matter of fact, there is some evidence that it was not so severe. In the seed-selection work conducted by the Experiment Station, it was apparently easier to find canes showing moderate or no loss from the disease in the old infected districts than in the newly infected ones. In the latter, the infected cane looked very much the same. This is a point, however, which must receive further attention.

Usually in Louisiana, only a single stubble crop is produced, and this differs from many of the tropical countries in which the crop is ratooned for many years. Consequently, there are no data in Louisiana on the effect of the mosaic on successive ratoon or stubble crops. The statements in the paragraphs above refer to new seed cane that has carried the mosaic infection for a number of years.

Root-Rot

The trouble commonly called root-rot or root disease has without question been an important factor in the crop yields of 1923 and 1924, especially in the latter year. This is not a new trouble or even a new development in Louisiana. It has been known in the state for a long period and has caused losses in certain years or on certain places when the environmental conditions were favorable. Root-rot is one of the old problems of the sugar industry. It occurs in practically every cane country, and in many, if not in most, it is the most troublesome of the cane diseases. Java, West
Fig. 2. A root-rot infected stool and a healthy stool of D. 74 cane growing side by side.
Indies, Hawaii and practically every other country as well as Louisiana, have had their root-rot difficulties.

The characteristics of root-rot vary to a considerable extent. In general, the affected plants grow slowly, often have a yellow color and usually stool poorly in the early part of the season, though in the latter part of the season there may be considerable suckering. In dry seasons particularly, the growth may be so slow that very few stalks of commercial value are produced. The roots show dead areas or sometimes are so badly rotted away that a whole stool can be pulled up with very little difficulty. Usually, also, the lower leaf sheaths of the affected stalks are cemented together by a white mold or mycelium though this is not always the case.

A dying of the upper leaves accompanied by a discoloration and rotting of the growing bud occurs also in severe outbreaks of root-rot. This characteristic of the disease is apparently the same as has been described from Australia as top-rot (17). There was considerable of this top-rot in certain sections of Louisiana in 1924, especially in the regions with the scantiest rainfall.

The effect of root-rot is more striking in a dry year than in a wet one, due to the fact that a plant with even a poor root system can absorb sufficient water from a wet soil to continue growth but it is unable to do so in a dry soil.

From the nature of root-rot, it is evident that it can be brought about by anything which causes the roots to decay or prevents their development. At various times in the past, a number of different organisms have been held responsible for this disease and it is possible, and even probable that a number of these play a part in its development under varying environment conditions. Among the organisms which have been reported in connection with root-rot, the following should be mentioned.

(1) Species of Marasmius. The Marasmius species are the ones which produce the white mycelium that cements the leaf sheaths together. These were about the first organisms associated with root-rot and for a considerable
Fig. 3. Root-rot on young stalks that were still connected to the seed stalks. Notice the decayed area on the outside and the lack of roots. This has been called the "acute" stage of root-rot.
time were the only ones thought to be responsible. Later, when these organisms were found to be less parasitic than was at first thought, a number of workers went to the other extreme and stated that Marasmius had nothing to do with the disease. However, it is not unlikely, when the true relationship of the different organisms has been carefully determined, that the Marasmius species will find some place in the root-rot problem. It is often the tendency with the development of a new idea to throw aside the old one.

(2) Species of Pythium. Certain Pythium species have been reported from Hawaii (4) and some other tropical countries in connection with root-rot. It is the belief that some of these are of considerable importance in certain countries.

(3) Species of Rhizoctonia. Several Rhizoctonia species have been reported from Porto Rico (5, 13, 14) and Barbados (1) in connection with root-rot and evidence has been presented showing that they are important organisms in the West Indies. These organisms are also very abundant on cane roots in Louisiana.

(4) Snails. In a recent article, Rands (16) has shown that snails eat holes in sugar cane roots and he claims that roots injured in this way are more subject to root-rot. It is hoped that Dr. Rands can continue his work and ascertain more fully what effect the snails have on cane growth. There is no question that injuries such as he describes are abundant on many cane roots.

It is worth while to discuss the relation of these various organisms in connection with the 1924 root-rot epidemic in Louisiana. The root-rot was studied through the whole season, from early in the spring until late in the fall.

In the spring, a condition existed which largely disappeared as the season advanced. In May and June, many young cane plants died. On examination it was found that the basal portion of the young plant, from the point of attachment to the mother stalk or the old stubble to above the surface of the ground, was shrunken and had an area of dead and decayed tissue on the outside. Frequently this de-
Fig. 4. The same stalks shown in figure 3 after thirty-six hours in a moist chamber. Out of the decayed areas has grown the mycelium of Marasmius.
cayed area extended entirely through the young stalk. This decayed area in every case examined was filled with Marasmius mycelium though it did not always show on the outside. When placed in a moist chamber, the dead area would become covered with a growth of the Marasmius mycelium. In figure 3 are shown some of these stalks as they came from the field split open to show the rotted areas; while in figure 4 are shown some of the same stalks after thirty-six hours in a moist chamber. This condition seems to be identical with what Nowell in a recent book (15) calls the "acute" stage of the root-rot disease. Such stalks were absolutely prevented from sending out any roots. This type of root-rot depleted the stands to a considerable extent in some sections. The Raceland section was seriously affected in this manner.

Later in the season, another type of the root disease developed. The proper number of young roots either did not form or as frequently happened, rotted after developing. The roots were red, often misshapen and usually showed lesions or rotted areas. In severe cases, the roots rotted back so that they were only stubs protruding from the stems, while in milder cases, they extended out for greater distances in the soil. In figure 6 are shown some roots characteristic of many cane fields in the state.

In culturing these affected roots, it was found that they did not contain a large number of different organisms. While a few saprophytic forms such as Trichoderma lignorum, Oedocephalum echinulatum, Mucor sp. and Fusarium sp. were very commonly present, it was found that a large percentage of the cultures also contained some of the Rhizoctonias which have previously been reported from the West Indies. A number of different species of Rhizoctonia were isolated from these roots. In the West Indies, these organisms are considered the most important of the cane root parasites.

It has been found that some of these Rhizoctonias are capable of producing root-rots very similar to the natural
Fig. 5. A characteristic root-rot hill. The basal portion is rotted, the root system is very deficient and the lower leaf sheaths are cemented together by the Marasmius mycelium.
condition in the field. In figure 7 are shown roots affected with root-rot which was produced by artificial inoculation with one of these fungi. The illustration shows an upper joint from a healthy stalk which was sterilized for fifteen minutes in a 1-1000 corrosive sublimate solution and then placed in a pot of soil which had been sterilized in the autoclave under fifteen pounds pressure and then inoculated with a pure culture of one of the Rhizoctonias. The photograph was made thirty-one days after the stalk was planted in the inoculated soil. The affected roots on the right side show the same misshapen and stubby appearance as those occurring naturally in the field. The roots were red to brown in color like the naturally infected roots. The Rhizoctonia was easily reisolated from the discolored roots.

The effect of one of these Rhizoctonias is also shown in figure 8. These cane joints were sterilized with corrosive sublimate and placed in large sterile tubes containing wet cotton at the bottom. When the roots were pushed out, one tube was inoculated with Rhizoctonia while the other was left as a check. The photograph was made thirteen days after the inoculation. The misshapen, short and discolored roots of the inoculated stalk form a strong contrast with the healthy roots of the check.

Many other experiments have been run and are being run, not only with the Rhizoctonias, but with various other fungi found on cane. It is expected that a thorough study will be made of these organisms. For this general discussion of the disease situation, it is sufficient to say that the Rhizoctonias which are very common on cane are capable under favorable conditions of producing a root-rot similar to that found in the field in 1924.

All of these organisms which attack the cane roots are weak parasites. If the cane is growing rapidly, the roots are not as easily attacked by the parasites as are those on plants which lack vigor. Consequently, the factors which decrease the vitality of the plants also make them more susceptible to root-rot attack. Such factors include poor drain-
Fig. 6. Misshapen, stubby and discolored roots, common on cane affected with root-rot. From such roots, cultures of Rhizoctonia have been easily obtained.
age, poor cultivation, too much rain, a severe drought, too heavy a soil, presence of root-eating grubs, beetles, snails, etc., and the planting of weak or badly infected cane. During the seasons of 1923 and 1924, there has been a combination of these factors with the result that there was a very heavy infection of root-rot and a severe loss. The wet season of 1923 permitted the root parasites to develop abundantly and to accumulate in the soil and on the cane, while the dry season of 1924 was ideal for the development of the root-rot. Louisiana has suffered before with the root-rot and probably will again but it is very unlikely that such a combination of unfavorable growing conditions will occur very often.

Root-rot has occurred quite generally over the sugar belt. It was much worse in some sections than in others due to variations in soil and growth conditions. The black soils were, of course, the most severely affected. These black soils, however, are nearly always affected. Even in very favorable years, the tonnage in these soils is reduced very heavily by the root-rot.

**Conclusions as to Cause**

From the above outline of the climatic conditions, the soil conditions and the diseases present, there can hardly be a question that all of these have had their influence on the cane yields. The weather and soil conditions have been ideal for development and spread of the red-rot and the root-rot. It is not possible to say just what percentage of the loss has been caused by the weather conditions, by the borer, by the red-rot, by the mosaic or by the root-rot. It is evident that some of these have been greatly influenced by the others and that the general crop condition is due to the whole complex.

**The Outlook**

While there is no way of predicting a crop condition in the future, there are certain things which have a bearing on the crop of 1925 and those to follow which should be mentioned.
Fig. 7. Root-rot, following artificial inoculation. The stalk was sterilized with corrosive sublimate and planted in sterilized soil which had been inoculated with a pure culture of a Rhizoctonia. Photograph thirty-one days after inoculation. The misshapen and discolored roots should be compared with the naturally infected roots in figure 6.
Fig. 8. Effect of Rhizoctonia on root development. Stalks sterilized with corrosive sublimate and placed in large sterile test tubes with wet cotton in bottom. Stalk on left inoculated with a pure culture of Rhizoctonia, stalk on right not inoculated. Thirteen days after inoculation.
The seed used in the fall of 1924 was far superior to that of the preceding year. It was much less infected with red-rot and when planted in soil with sufficient moisture for growth showed a very high germination. As has been noted, some of this cane was showing a germination as high as 70 or 80 per cent in the fall. With such seed, the prospects for good stands and vigorous cane in the spring of 1925 are favorable.

The prospects for the seed which was planted early in a soil too dry for germination are not so good. Furthermore some of the cane that was pithy and hollow should be watched.

In general, however, it can be said that the seed situation is favorable.

The soil condition in the fall of 1924 was in general better than for a number of years. The drying out of the soil has been a good thing for it. It has improved the physical condition and doubtless decreased the number of deleterious soil organisms which are common in wet, packed, sour soils. In some places, the dry condition has prevented a satisfactory preparation of the soil for planting but this is probably of less importance than the general improved condition.

As a result of the activities of the Agricultural Committee of the American Sugar Cane League, a great interest has been aroused among the planters in regard to the importance of new varieties and the use of better seed. A very successful series of meetings, arranged by this Committee, was held by the Experiment Station and the Extension Division of the University in September and the large attendance was ample evidence of the general interest in this work. There is no question that this general interest has resulted in the planting of much better seed than formerly. The questions of new varieties and the value of seed selection will be treated in paragraphs to follow.

With the approval of the Board of Supervisors of the University, the Experiment Station has entered upon a cooperative contract with the progressive and generous
owners of the plantations enumerated below, for conducting a series of carefully planned experiments, that will greatly facilitate the gathering of dependable observations on the behavior of new canes in different portions of the state and upon the sugar cane problems. By these agreements the Experiment Station furnishes the seedling canes, provides a specialist to visit the plats at proper intervals to make all needful notes on resistance to disease, etc., and will make all necessary chemical analyses, while the plantation owners cultivate the crop at their own expense, all in accord with a detailed plan approved by the Agricultural Committee of the American Sugar Cane League. These “Test Fields” are located as follows: On Glenwood Plantation, at Napoleonville; on Upper Ten Plantation, at Race-land; on Reserve Plantation, at Reserve; on Sterling Plantation, at Franklin; on Dr. Young’s Plantation, at Youngsville, and on the Penitentiary farm at Angola. The work started in the fall of 1924 on these plantations included tests of new varieties, seed selection work, seed treatment work and fertilizer and rotation experiments.

**P. O. J. and Other Seedlings.**

During the season of 1924, there has been a great deal of interest aroused in regard to new varieties, especially the P. O. J. seedlings. The three capital letters adopted as a part of the name designate the origin of these canes. They are abbreviations of the three words that designate the Government Experiment Station of East Java. The ones which have been introduced into the United States and are now receiving the most attention, such as the P. O. J. 234, 213 and 36, are hybrids of one of the small Indian canes which are highly tolerant to mosaic and root-rot, crossed on some of the larger varieties. They are canes of rather small diameter and high fibre content, but are vigorous growers, more or less tolerant to mosaic and quite resistant to root-rot. Futhermore they germinate exceptionally well and the planting of one running stalk will usually give a good stand. This means a great saving in seed. These varieties were introduced into Argentina and have largely replaced the native canes
there. They have also been introduced into Porto Rico and are promising well in that country. These canes have not been very pleasing to mill men in some of the tropical countries. The small size of the stalk and the clinging shucks also increase the harvest expense. In some of the tropical countries the harvest cost of some of the small canes like the Uba, is about twice as much per ton as with ordinary canes, but the high tonnage secured has compensated for these objections.

Most of the cane sugar experiment stations of the world have engaged in work along the line of importing varieties from other countries, and developing new seedling canes. The late lamented Dr. W. C. Stubbs, for many years Director of the Experiment Stations of Louisiana, took great interest in this work. Among the seedlings that he imported from Demarara are the now well known D 74 and D 95. The L 511 is a seedling produced at the Sugar Experiment Station, Audubon Park. Thousands of seedlings and many varieties more or less popular in other cane growing countries, were tested and discarded as not being any better than the standard canes now being cultivated.

When the Federal Horticultural Board instituted severe restrictions on importing canes and cane seeds into the Continental United States, our work along these lines was brought to a halt, as seeds and canes invariably died in quarantine.

In 1918, the Director of the Louisiana Experiment Stations, W. R. Dodson, requested the United States Department of Agriculture to undertake to germinate cane seeds, and to import cuttings of promising seedlings and new varieties, and grow them at Washington, D. C., until they could meet the quarantine regulations, and then send them to Louisiana. The following quotation is made from a letter under date of December 27th, 1918, addressed to United States Senator, Edward J. Gay, which explains the status of affairs at that time:

"With the results thus far attained, I think we can not afford to give up the propagation of seedling canes, and yet, with the difficulty of securing good seed, it seems like it
will be practically impossible for us to comply with the requirements of the Federal Horticultural Board and still get seedlings that will germinate. The delays in getting the seedlings through the Inspection Service cause them to lose their vitality, if indeed they are not destroyed by the fumigation process to which they are subjected.

"There has been a good deal of correspondence between Mr. Taggart, of the Sugar Experiment Station and the Federal Horticultural Board, regarding this matter, and the correspondence has not been very satisfactory to us. I want to now try another way of securing seedlings without setting aside any of the regulations or requirements of the Federal Horticultural Board, and this is, to have the Department of Agriculture germinate the seeds that may be imported and then send us the cuttings from the greenhouses at Washington.

"With all of the money spent for the introduction of valuable plants, it seems to me that it would be a small consideration for the Department to give to the sugar planters, to germinate a good number of seedlings each year and send the first cuttings to the Station at Audubon Park each year, for field test. Can't you take this matter up and see what arrangements can be made for accomplishing this end? It will soon be time to secure seeds from the tropics and there ought not to be any time lost if we are going to get a crop of seedlings this year.

"Our correspondence has been mainly with Mr. Peter Bisset, of the Bureau of Plant Industry, though I suggest that you might find Dr. B. T. Galloway, Plant Pathologist of the Bureau of Plant Industry, Foreign Seed and Plant Introduction, a valuable man to communicate with you.

"Very respectfully,
(Signed) W. R. DODSON, Director."

Senator Gay took a very active interest in this matter, and early in 1919, at his request, Mr. Dodson made a special trip to Washington, D. C., to attend a conference with Dr. W. A. Taylor, Chief of the Bureau of Plant Industry, Dr. B. T. Galloway, Pathologist of the Foreign Seed and Plant
Introduction Division, Dr. L. O. Howard, Chief of the Bureau of Entomology, and United States Senator Edward J. Gay, to discuss the plan of securing seedling canes.

The U. S. Department of Agriculture had already started some sugar cane work in 1918 because of the serious situation in Porto Rico and the representatives of that Department agreed to enlarge the work as funds were available. As a result Senator Gay agreed to urge an appropriation to take care of the work. He faithfully carried out his promise, enlisting the aid of other Louisiana representatives in Congress and that of representatives from other states, engaged in the production of sugar cane syrup, and together they secured the desired appropriations.

The Department worked out its owns plans for propagating these canes in Florida at Canal Point, and the plans for the work have been enlarged as rapidly as available funds would permit.

It was just at this time that some of the P. O. J. seedlings were beginning to be promising in certain of the sugar producing countries. The Louisiana Experiment Station attempted to secure importation of these seedlings, and arranged with the Director of the Experiment Station of Argentina to ship several barrels to the Federal Horticultural Board, Washington, D. C., for use in Louisiana. This shipment was found to be infected with mosaic and was destroyed. The Bureau of Plant Industry thereafter took the initiative in importing seeds and seedlings and imported a number of P. O. J. seedlings directly from Java. These were grown at Canal Point, Florida, and later shipped to Louisiana. The Louisiana Experiment Station has since made no attempt to bring in cane from without the borders of the United States. It is considered as unsafe to import any considerable quantity of any cuttings, and importations of the U. S. Department of Agriculture have been restricted to small pieces of cane that could be minutely examined and grown under quarantine in the greenhouses in Washington, D. C., for a year. We believe that this policy has been on the side of safety and that the Federal Horticultural Board has acted wisely in not taking any chances
on importing any new diseases or insect pests into this country, through sugar canes.

The first seedlings received by the Sugar Experiment Station, from the Department, were obtained in March, 1922, and we have received up to this time approximately 2500 seedlings. Out of this number we have something like 20 that are quite promising, as being highly tolerant to the diseases that are prevalent in the State and showing good tonnage and high sucrose content. There are probably 200 that are worthy of further cultivation and observation.

The Bureau of Plant Industry of the U. S. Department of Agriculture, and the Louisiana Experiment Stations, are now working under a memorandum of agreement, recently formulated, that defines our relations so clearly in the cooperation, that there should be the most cordial and effective relationship in this work.

The Bureau is to investigate sources of promising new seedlings and varieties, in foreign countries, bring them to Washington, D. C., and keep them for a year, under observation in a sugar cane quarantine greenhouse at Arlington farm, and then send those that show freedom from disease and insect pests to the field stations of the Bureau of Plant Industry and to the Louisiana Station. They will continue their work of producing and germinating sugar-cane seeds at Canal Point, Fla., and send cuttings of all promising seedlings to the Louisiana Stations and also send seeds when a surplus of seeds of desirable crosses are available.

The Louisiana Station is to plant in test plots all seedlings and other varieties from the Bureau, and to make records of their susceptibility or resistance to disease, insect pests, etc., and on the rate and character of growth, make such chemical analyses as may seem necessary, etc. They will plant and cultivate all of these seedlings so long as they do not require an area to exceed twenty-five acres. The best of these seedlings will be grown in increase plots, for distribution to cane planters, until these plots occupy an area of not more than twenty-five additional acres. The Louisiana Station will also provide funds to the extent of $1,000 a
year toward meeting the expenses of enlarging the seedling propagations, and preparation for shipment of canes to Louisiana from Florida.

The disposition of the products of the Experiment Station test fields at Baton Rouge and the field station of the Bureau of Plant Industry at Houma, La., will be made in accordance with plans approved by the Chief of the Bureau of Plant Industry and the Director of the Experiment Stations, annually. The Experiment Station and the Bureau will exchange notes and records on the behavior of these seedlings and varieties, annually, or oftener, if desirable. Both parties to the agreement will be free to publish data on the performance records of these canes, providing such results are credited to the cooperative work. This agreement was formulated and signed after a conference held at the request of the Director of the Louisiana Experiment Stations, and Dr. E. W. Brandes, in charge of the Sugar Investigations of the Bureau of Plant Industry, between W. A. Taylor, Chief of the Bureau of Plant Industry; Dr. B. T. Galloway of the Division of Foreign Seed and Plant Introduction; Dr. K. F. Kellerman, representing the Federal Horticultural Board; Dr. F. H. Chittenden, of the Bureau of Entomology; Dr. E. W. Brandes, in charge of Sugar Investigations; and W. R. Dodson, Director of the Experiment Stations, Louisiana.

All of the above named gentlemen are interested in the sugar cane situation in Louisiana, and want to do what they can to aid the work on seedling canes. More liberal appropriations of the Federal Government for the work of the Bureau on sugar cane seedlings at Washington and in Florida, and of State appropriations for the work at Baton Rouge, would increase the volume and probable value of this work.

At present there are only a few acres of the P. O. J. seedlings in Louisiana. They look promising in many ways. It may be that they will produce more than the D 74 and Purple canes ever did. That is really what happened in Porto Rico with the Uba variety. The Uba in Porto Rico
outyielded the standard varieties even where the mosaic was not present. If the P. O. J. seedlings do the same in Louisiana, they may replace the D 74 and Purple canes, but as to this, only time will tell.

Seed Selection Work

As a possibility of bringing the cane industry back to normal, seed selection work has been advocated by the Experiment Station. It has been demonstrated by the selection work carried on at the Sugar Station over a four-year period that the tonnage can be materially increased and the amount of seed necessary for planting decreased. It has also been demonstrated that strains of D 74 and Purple can be selected which show a very marked resistance to mosaic. The strain of Purple which has been selected at the Station has held its resistance to the disease for three years though it has been growing in a field that showed a 100 per cent mosaic infection.

In the series of meetings held in September, two things were advocated in regard to the seed selection work.

(1) For the general planting, only good, healthy blocks of cane should be used for seed. All the poor, scrappy, root-rot infected cane should be sent to the mill. In former years, the poor diseased cane has been used for planting. Good crops have been produced from scrappy seed, yet the general use of such seed is a dangerous practice.

(2) Each planter should start a seed plot. For this the cane should be very carefully selected on the stool basis. Only stools showing at least four large stalks, an apparent freedom of root-rot and borers, and a tolerance to the mosaic should be used. The cane grown in the seed plot is to be used for propagation purposes the following year. By this stool selection, it is believed that the cane can be gradually relieved of the heavy root-rot infection.

During the fall of 1924, a considerable amount of stool selected cane was planted. Some planters selected only a small amount while others have fifteen to twenty acres or more. As there is selected cane in nearly every section,
there will be an excellent opportunity in 1925 to compare this with the unselected cane and with the P. O. J. seedlings. The selected fields seen in the fall of 1924 were showing germination with a vigor that is very unusual.

From the tests that have been made at the Sugar Station, it is believed that the D 74 and Purple canes can be brought back to a profitable basis again. The D 74, Purple and other standard varieties, have been very valuable canes in Louisiana. They have been misused by the continual planting of the poorest and most diseased seed. This has permitted the gradual accumulation of the root organisms both in the soil and on the cane. These varieties should be given a chance to come back by careful selection work.

Whether the P. O. J. or other seedlings ultimately prove to be superior to the standard Louisiana canes or not, the crops of the next few years must be made with the latter varieties. It will take a number of years to sufficiently try out the new varieties and propagate them so that there will be sufficient seed for planting. Any improvement of these immediate crops is important. If the new seedlings are found superior, they will in time naturally take the place of the other canes; if not, then the selection work will mean a permanent improvement of the present varieties.

Summary

The sugar crops of 1923 and 1924 in Louisiana were very short. The 1924 crop was especially poor.

No single factor can be given as the cause of these poor crops. They were caused by a complex; including weather conditions; cultivation, drainage and fertilization conditions; cane borer infestation; and the attack of several diseases.

The season of 1923 was next to the wettest year on record, while 1924 was the driest. There was not sufficient moisture in most sections in 1924 to make a crop. The local variations in rainfall showed a marked effect on the crop in different sections.

The excessive rainfall of 1923 prevented proper culti-
vation and the drainage systems were not able to take care of the excessive amount of water. The soils remained watersoaked and were in a poor physical condition.

The cane borer infestation was heavy in 1923. This permitted a severe red-rot infection with the result that the seed cane used in the fall was very inferior.

Three diseases had their effect on the crop, the red-rot, the mosaic and the root-rot.

The red-rot decreased the sucrose content of the juice in 1923 and materially hurt the germination of the buds. This was one of the reasons of the thin stands in 1924.

The mosaic decreases the vigor of the cane and undoubtedly produces a considerable loss. The oldest infected districts, however, were not the ones showing the poorest crop conditions.

The root-rot aided by weather conditions, was very important. This showed up in practically every section of the state.

It has been demonstrated that the same fungi which are given as the cause of the root-rot in the West Indies were on the roots of the Louisiana canes. Furthermore the root-rot condition has been produced upon roots by artificial inoculation.

The seed cane used for planting in the fall of 1924 was superior to that of previous years.

The P. O. J. and some other seedlings which have been introduced into Louisiana show considerable promise but it will take several years to test them out and propagate enough seed for general planting.

The selection of healthy seed cane is advocated in order to gradually free the canes of the excessive root-rot infection and to reduce the loss from mosaic.

Literature Cited


17. Tryon, Henry. Top-rot of the sugar cane. Queensland, Bureau of Sugar Experiment Stations, Div. of Pathology, Bul. 1. 1923.